GREENVILLE YARD, TRANSFER BRIDGE SYSTEM
Jersey City
Hudson County
New Jersey

HAER No. NJ-49-A



PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORDS
National Park Sërvice
Northeast Region
Philadelphia Support Office
U.S. Custom House
200 Chestnut Street
Philadelphia, P.A. 19106

HISTORIC AMERICAN ENGINEERING RECORD
GREENVILLE YARD, TRANSFER BRIDGE SYSTEM

HAER
NJ
9-JERCI,
19A-

HAER No. NJ-49-A

**LOCATION:** Jersey City, Hudson County, New Jersey

USGS Jersey City, NJ Quadrangle,
UTM Coordinates: 18.578260.4503280

**DATES OF CONSTRUCTION:** 1904, 1910, 1925, 1931, 1943, 1945

**ENGINEER/BUILDER:** J.A. Bensel, F.L. DuBosque, W.C. Bowles, and W.H. Brown, engineers, Pennsylvania Railroad (PRR); American Bridge Company, Trenton, New Jersey, and Steele & Condict Co., Jersey City, New Jersey, principal contractors

**PRESENT OWNER:** Consolidated Rail Corporation (Conrail), Philadelphia, Pennsylvania, and the New York Cross Harbor Railroad, Brooklyn, New York

**PRESENT USE:** Railroad car float transfer bridge

**SIGNIFICANCE:** The Greenville Yard Transfer Bridge System is the last surviving example in New York Harbor of a suspended-type car float transfer bridge. The innovative design of the transfer bridge was introduced by PRR engineers in 1888, and proved superior to other types in ease and speed of operation. The design was perfected and electrified with the building of the Greenville facility in 1905, and became the standard adopted by many other railroads.

**PROJECT INFORMATION:** The Greenville Yard Transfer Bridge System was recorded in December 1996 by the Cultural Resource Group of Louis Berger & Associates, Inc., East Orange, New Jersey, for Conrail. The recordation was undertaken pursuant to Condition 1 of Permit No. 0906-92-0007.2 issued by the State of New Jersey, Department of Environmental Protection, on October 27, 1995. Project personnel included Richard M. Casella, Senior Architectural Historian, and Rob Tucher, Senior Photographer.

**DESCRIPTION**

The Transfer Bridge System is a waterfront facility on New York Bay, located on the eastern edge of the former PRR Greenville Yard in Jersey City, New Jersey. The facility consists of six individually numbered railroad car transfer bridges (9 through 14) over which freight cars are moved from shore onto steel barges known as car floats. Once fully loaded with up to 20 freight cars; the floats are moved by tugboats across the bay to Brooklyn, New York. Each transfer bridge serves one car float and consists of two separate spans connected to each other with a hinge joint and suspended at the joint, and at the float end by steel cables and eyebars hung from two overhead steel-truss support structures. The bearing at the shore end of the bridge is a roller and socket hinge to allow vertical movement. The entire bridge can be raised or lowered by electric motors to accommodate the level of the float, which varies with its load and with tide height.

Each of the six transfer bridges consists of two spans: a riveted plate girder through span which is the main span and is referred to on plans as the *bridge*, and a shorter steel-beam deck span, called the *apron*. The main span, or bridge, can be considered a half-suspended span, with one end resting on shore and the seaward end suspended by a superstructure, cables, and equipment similar to a vertical lift bridge. The bridges are double tracked with a center girder and measure 80' long and 34' wide, with 6'-deep plate girders. The six bridges are essentially identical in construction except for the upper corners of the girders, which are square on Transfer Bridge Nos. 9, 11, 12, and 14, manufactured by American Bridge Co., Trenton, New Jersey, and rounded on Transfer Bridge Nos. 10 and 13, manufactured by McClintic Marsh Co., Pittsburgh, Pennsylvania.

The apron is a steel-beam-deck bridge 30' long and 34' wide, with 2'-deep I-beam deck girders. The apron is connected to the shore span with a 3-1/2" pin-type hinge joint. The float end of the apron is fitted with movable chrome-nickel steel pins, measuring 5" by 7" by 7'. Known as toggle bars, the pins slide into sockets on the car float to provide a rigid connection between the two. During docking operations, the float and apron are horizontally and vertically aligned, pulled tightly together with winch-drawn cables and hawsers, and then rigidly locked together with the toggle bars. The bars maintain the continual vertical alignment of the rails on the bridge and the float necessary for the transfer of the cars from land to float. The rails on the apron can be more precisely adjusted horizontally with manually operated screw-and-ratchet-type rail adjusters. The apron is additionally connected to the center girder of the main span with a hydraulic piston, known as an apron operating strut. The strut operating system replaced an earlier arrangement which adjusted the apron by an electric motor-operated cable passing through a sheave mounted on the outboard end of the apron.

The bridge and the apron are suspended by a combination of steel cables and eyebars from two separate steel-truss superstructures, variably referred to on plans as a tower, a gallows frame, or a gantry. Structurally, the towers consist of two main plate girders 75' in length, with a clear span of 51' over the bridge and apron below. The main girders are supported by four I-beam legs joined and crossbraced with steel angles. The towers rest on concrete foundations on wooden pile subfoundations. The main girders carry the lifting machinery and counterweight sheaves and are enclosed with a gable-roofed sheet-metal house, known as the tower housing or the sheave house. The corrugated-metal siding and roofing of each of the six bridge sheave houses and apron sheave houses overlap to form two continuous houses atop the towers, each 470' long. The apron tower is 12' wide and 51' tall, while the bridge tower is 15' wide and 44' tall.

The apron and bridge towers are joined to one another with steel beams approximately 10' and 28' above the foundations which carry steel stairs and walkways. There are three operators' houses located between Transfer Bridge Nos. 9 and 10, 11 and 12, and 13 and 14, each approximately 10' by 40', with sheet-metal roof and walls. Each operator's house contains electrical controls and switching gear for the operation of two adjacent transfer bridges. Half of each operator's house is supported by the apron tower for the bridge it controls. Metal sash windows in the endwall overlooking each bridge provide the bridge operator with a clear aerial view of the car float docking and loading/unloading operations.

Each apron is suspended by four 1-1/4" steel cables which attach to the outboard corners of the apron, pass over eight 4' diameter sheaves mounted on the apron tower main girder, and connect to two 42,000-pound counterweights hung within the tower legs. Each bridge is suspended by eight 2-1/2" cables, four attached to the center girder and two attached to each outside girder, which pass over 16 4' sheaves on the bridge tower main girder, and connect to four 53,000-pound counterweights hung within the bridge tower legs. The counterweights are constructed of stacked cast-iron plates or, in the case of Transfer Bridge No. 9, concrete and iron.

In addition to the counterweight system, which carries approximately 90 percent of the bridge's dead weight, the bridge is suspended by four interconnected vertical lifting assemblies, each consisting of eyebar linkages, a lifting screw, and a lifting-screw drive mechanism. Two of the lifting assemblies are attached to the center girder, and two are attached to each outside girder. The eyebar linkages each consist of two sets of pin-connected steel eyebars. Each eyebar measures 7' by 2' by 2-1/2" thick, and is connected to the bridge girders and the lifting-screw eyes with 6"-diameter pins. The threaded lifting screws are 7" in diameter and 22' long, and are threaded into cast-steel internally-threaded drivenuts. The drivenuts are also externally threaded and mesh with worm drive gears mounted on a continuous drive shaft, which interconnects all four lifting-screw drive gears. The drive shaft is turned by two 100-horsepower General Electric motors with reduction-gear transmissions. Each lifting screw is designed to travel 4.17' per minute under a load of 170,000 pounds, to provide a total lifting capacity of 680,000 pounds per bridge.

## HISTORICAL INFORMATION

## BACKGROUND

The function of a railroad car transfer bridge is to allow the movement of cars by rail from shore onto either a self-propelled vessel known as a car ferry, or onto a type of barge known as a car float (car floats do not have holds and are technically not barges).. Car float transfer bridges have also been called float bridges and drop bridges, and consist of a bridge hinged at the shore end and supported at the outer end by either flotation, a suspension apparatus, or a combination of the two, which allows adjustment of the bridge to the varying height of the vessel or the tide.

In a general sense, transfer bridges date back to antiquity, when carts, stock, and people moved over wooden ramps onto ferries or other vessels. A *wharf drop* is a section of dock hinged and supported by ropes that can be adjusted for tide height and used in loading freight into the holds of ships; this dates to the sixteenth century and probably earlier. Carl Condit, in his book *The Port of New York,* states that by 1827, Robert Fulton had invented a movable float bridge that could be adjusted for the tide height by hoists and counterweights, which he used in conjunction with his ferry, *Jersey.* The ferry ran between Jersey City and the foot of Broadway. The first railroad car transfer bridge in the U.S. was built under a joint venture of the Camden and Amboy Railroad and the Baltimore and Potomac Railroad in 1838 to provide car ferry (also called train ferry) service across the Susquehanna River between Havre de Grace and Perryville (Condit 1981:48-49).

Railroad car ferries appear, from the historical literature on the subject, to have preceded the development of car floats. The first car ferry of the PRR was the *Susquehanna.* It carried baggage cars on its upper deck and crossed the Susquehanna River at Perryville on the PRR's Wilmington to Baltimore route. In 1854, the *Susquehanna* was replaced with the *Maryland,* a 220' iron-hulled side-wheel steamer. The vessel was equipped with two tracks on her top deck and accommodated an entire passenger train in one trip. The *Maryland* later was put in service in New York Harbor, connecting the PRR at Jersey City with the New York, New Haven & Hartford Railroad (NYNH&H) at Oak Point (Burgess and Kennedy 1949:391-393).

The history of the first car float in New York Harbor or elsewhere was not determined, but by the Civil War, screw-propelled tugboats, with sufficient power and maneuverability to manage large displacement barges, were in common use. Conversion of a lighter, or barge, required only the addition of a flat deck and the laying of track. The first railroad car transfer bridges in New York Harbor were of the pontoon type, built in 1866. By the early 1880s, the PRR was loading three-track car floats with a capacity of 14 cars at its Harsimus Cove terminus in Jersey City at the rate of 150 cars per day. Cars were loaded over a 100' wooden Howe truss transfer bridge, suspended by heavy iron chains run over sheaves supported on wooden frames (Mordecal 1885:36).

In 1888, the PRR built a suspended and counterbalanced car float transfer bridge at its Harsimus Cove yard in Jersey City. According to J.A. Bensel, the PRR engineer in charge of the project, the suspended design was not a new concept, but it was the first of its type in New York Harbor. Previous to that time, all of the transfer bridges in the New York Harbor area were of the floating pontoon type. The new design incorporated the basic principles of the vertical lift bridge designed and built along the Erie Canal by Squire Whipple during the 1870s. It is curious that five years after Bensel's paper was published, J.A.L. Waddell was granted a patent for a cable-operated, counterweighted vertical lift bridge design, which shared numerous similarities with the Bensel design. Waddell's bridge became a standard form that continued to be built well into the twentieth century (Bensel 1888:309; French 1917:61-63; Hovey 1926:146, 154).

The suspended transfer bridge design offered major improvements over the pontoon transfer bridge. Since the suspended bridge did not rest in the water, it was not subject to deterioration and damage from sea water, waves, and ice, which eventually lead to the unexpected sinking of the bridge. Secondly, to make the rigid connection between a transfer bridge and a loaded car float requires that loaded cars be rolled onto the bridge to cause it to sink to the level of the car float. Conversely, the bridge must be jacked or winched up to line up and connect with an empty car float riding high in the water. Both of these operations are time consuming and dangerous, particularly in rough water (Bensel 1888:309; *Engineering News* 1890:67-68; French 1917:61-63).

In addition to eliminating these major drawbacks of the pontoon bridge, Bensel's Harsimus Cove design was steam powered and introduced two important mechanical features which dramatically increased safety and car handling capacity. To adjust the bridge up and down, the bridge was suspended from an overhead truss structure, called a gantry or gallows frame, by long vertical screws which could be raised or lowered by a large nut turned by a power-driven worm gear. The dead weight of the bridge was carried by a system of cables, sheaves, and counterweights to reduce the operating power required to drive the adjusting screws. The second major innovation was the introduction of a short, flexible span, called an apron, between the car float and the bridge. The apron was designed to absorb the huge torsional strains put on the bridge by the car float as it rocked from side to side during loading, unloading, or heavy wave action. Because of the superior attributes of the design, it was quickly adopted by the New York Central Railroad and later by several other major railroads with car floating operations on the harbor as well (*Engineering News* 1890:67-68; French 1917:61-63).

The next major development in transfer bridge technology was again introduced by the PRR with the construction of the huge Greenville freight yards and car float transfer bridge facility in 1904. The Greenville improvements were the result of several factors. The tremendous demands at the time for increased railroad freight service to New York and New England warranted large expenditures on research, design, and equipment to move more traffic. French noted in his seminal paper on the subject of transfer bridges that "these structures constitute the very throats of these tidewater railroad terminals and their effective operation is vital to the successful movement of the very important freight traffic" (French 1917:59). French's paper was written in 1917, when 82 transfer bridges were in operation, loading as many as 7,000 cars on and off 400 to 500 car floats every day.

Another major factor behind the advances introduced at Greenville was the experience and knowledge gained by designers of the Harsimus Cove bridges through their operation. The PRR bridge engineering department had an established reputation for its bold and brilliant ingenuity. Over the previous five decades, the group had claimed dozens of "firsts" and world records in bridge design and construction, in part due to its ability to put the latest technological advances of the day into practical use. At Greenville, it was the recently perfected field of electric power that provided the PRR engineers with the means to vastly improve the speed of a car float transfer bridge operation.

The principal achievements of the 1905 Greenville transfer bridge design were the improvement of the vertical lift screw, the application of electric motors and electrical controls to the operation, and the addition of a live load counterweight system. These improvements have been attributed to F.L. DuBosque, who worked for the PRR in Jersey City as assistant engineer of floating equipment (*Railway Age* 1905:403). While the Harsimus Cove lifting (or adjusting) screws carried only the dead load of the bridge, Greenville's screws and its drive assembly were nearly doubled in size, increasing its load capacity to carry both dead and live load. The screws and the associated suspension equipment were rated for a capacity of 300 tons. The screws were fitted with two 50-horsepower electric motors and electrically-operated relay controls which allowed very fine adjustment of the bridge while under full load. With the ability to easily correct the level of the bridge to the constantly varying elevation of the car float during loading/unloading and tide change, the bridge and apron could be kept more level with the float, greatly increasing the speed of the operation (*Railway Age* 1905:401).

The final major problem solved by DuBosque was that caused by the transference of the live load on the apron to the car float, which caused intermittent submergence of the float during loading operations. This situation created an vertical angle, or "hump," at the hinge joint between the bridge and the apron, and introduced oscillations, or "bobbing," to the car float, both of which impeded efficient operations. A counterweight system with an upward reaction of 120 tons was added to the apron which could be controlled by the operator as needed by applying or releasing friction brakes on the system (French 1917:61-63; *Railway Age* 1905:400-401).

The PRR's Greenville transfer bridge design has been proven superior by many measures. Nearly identical bridges were built in 1908 by the NYNH&H at its Oak Point terminal in the Bronx, and by the Baltimore and Ohio Railroad at its St. George, Staten Island, terminal in 1912. The PRR was apparently very satisfied with its design and added three more of the bridges to the Greenville terminal, the last of which was built in 1945. When the facility was destroyed by fire in 1931, the PRR rebuilt the complex following the original plans. The slower but much simpler and cheaper pontoon bridge remained popular through the twentieth century for smaller car float transfer operations (French 1917:65).

## HISTORY OF THE GREENVILLE YARD TRANSFER BRIDGE SYSTEM

The Greenville Yard Transfer Bridge System was first constructed in 1904, in conjunction with the building of the Greenville Yard. In that year, three transfer bridges (Nos. 11, 12, and 13) were erected. In 1910, Transfer Bridge No. 14 was added to the south end of the structure, and in 1925, Transfer Bridge No. 10 was added to the north end of the structure. On January 1, 1931, a spectacular fire destroyed the entire facility. Following the fire, several bridges, aprons, and other components were salvaged and utilized in the reconstruction. In 1943, Transfer Bridge No. 9 was added to the north end of the structure, and in 1945, Transfer Bridge No. 12 was completely rebuilt.

The original three-bridge transfer structure, built at Greenville in 1904, was essentially an improved version of the PRR's innovative Harsimus Cove, New Jersey, car float transfer bridge facility built in 1888. The overall plan and design of the Greenville facility was a result of a study made by a committee of PRR line officers, consisting of J.T. Richards, chief engineer maintenance of way; L.H. Barker, assistant chief engineer; and R.M. Patterson and Wilson Brown, superintendents. The actual design and construction were under the direction of W.C. Bowles, assistant engineer of construction, and F.C. Richardson, principal assistant engineer, both of whom reported to William H. Brown, chief engineer of the PRR. The "remarkable development in the machinery of the transfer house" was principally the work of F.L. DuBosque, assistant engineer of floating equipment for the PRR at Jersey City. DuBosque worked closely with the engineers and machinists at the Steele & Condict Company of Jersey City, builders of the lifting machinery. The other contractors involved in the project included Henry Steers, Inc., of New York City, builders of the foundations, steelwork, pile racks, bridges, and aprons, and the Cooper-Wigand-Cooke Company and the R.P. & J.H. Staats Company of New York, erectors of the transfer bridge superstructure and the transfer machinery housings (*Railway Age* 1905:403).

Following the completion of the Greenville yard, a detailed article on the facility, focusing on the state-of-the-art transfer bridge arrangement, appeared in *Railway Age* (1905:397-403) (see Appendix). The article provided several photographs, plan and elevation drawings, and detailed drawings of the important mechanical components (see pp. 13-19, below).

In 1910, to meet the increase in freight traffic along the line, a fourth transfer bridge, No. 14, was added to the south end of the group. The bridge, apron, and superstructure work was contracted to Lewis F. Schoemaker & Company, Schuylkill Bridge Works Division, Philadelphia, Pennsylvania. Virtually all aspects of the structure and equipment were identical to the previous bridges. The sheet-metal transfer house, which sheltered both superstructures under one roof, was of wooden framing and matched the earlier structure. The apron for this bridge was rebuilt in 1919, following a new design which strengthened the floor and hinge connections (Conrail Microfilm Drawing No. 118396, 1910).

In 1924, plans were drawn for the addition of Transfer Bridge No. 10 to the north end of the group; the bridge was built and completed in 1925. The new construction required the removal of the existing pile ice fence and construction of a new and longer fence slightly further north. As with Transfer Bridge No. 14, Transfer Bridge No. 10 blended in seamlessly with the older adjoining structure, and other than minor improvements in the strength and capacity of the structure, it was essentially a mechanical twin to the others (Conrail Microfilm Drawing No. 118896, 1924).

On January 1, 1931, at 4:30 pm, a fire broke out on the wooden superstructure over Transfer Bridge No. 10 during the loading of a car float with 25 cars belonging to the NYNH&H. A short circuit in an electric motor was ultimately blamed for the fire. High winds fanned the flames, and within 15 minutes the wood-frame transfer house enclosing the two bridge suspension structures was completely engulfed in flames. The fire spread rapidly to the bridges and four car floats below. One injury, a fractured ankle, was sustained by an employee who was trapped by the flames and jumped down a burning stairway to escape. Three clerks, one of whom turned in the first alarm to the Jersey City fire department, managed to escape with their personal belongings and their typewriters.

The fire department responded with nine pieces of equipment, but as there were no roads out to the transfer bridges, hoses and firemen were loaded onto engines and tenders and taken by rail the one mile out to the fire. Twenty tugs and fire boats rushed to the scene from around the harbor and began pouring a deluge of water on the fire while more than 50 firemen fought the blaze from the shore side. As the fire continued to spread, a second alarm was sounded, bringing more Jersey City firemen and equipment to the scene. Three blazing car floats were pulled out into the bay and extinguished, sustaining various amounts of damage. The just-loaded NYNH&H car float and its load of cars was also pulled free and extinguished, but was considered a total loss.

The spectacular blaze, visible from other shore points around the bay, raged out of control for two hours and threatened to spread to other shorefront structures along the heavily built-up Jersey shore. The fire was extinguished after two more hours of heavy firefighting. The total loss was estimated by the PRR at between $500,000 and $1,000,000. Three hundred men were initially out of work, but within two days were put to work on the repair work or at the other PRR yards in Jersey City (*Hudson Dispatch* 1931a:1; *Jersey Journal* 1931:1; *Jersey Observer* 1931:1, 18).

The fire destroyed the entire superstructure of the transfer bridge facility as well as most of the machinery. Several of the wooden Howe truss bridges and the aprons were completely destroyed. The railroad salvaged and reused many of the components in order to get one of the bridges operating as quickly as possible. With the Greenville bridges completely out of service, the PRR immediately began rerouting freight cars through its Jersey City and Harsimus Cove transfer bridge facilities and through the Lehigh Valley Railroad's car float terminal, also in Jersey City (*Hudson Dispatch* 1931b:2).

Within days of the fire, the American Bridge Company of Trenton, New Jersey, was contracted to rebuild the entire transfer bridge facility and supply three new plate-girder main spans and aprons for Transfer Bridge Nos. 10, 13, and 14. The fact that the transfer bridges were rebuilt essentially identical to the old bridges is testimony to the soundness of the original design. The major changes that were made were in the interest of fireproofing the facility, and included the elimination of wooden framing in the superstructure, the building of two separate sheet-metal "sheave houses" around the upper level of the bridge and apron superstructures, and the building of separate sheet-metal operators' houses at the second level between the bridges. The result was a more open facility with outside steel stairways and exposed structural steel framework instead of the one main "transfer house" which had sheltered the whole operation.

In October 1939, the New York Bay Railroad Company (the division of the PRR which operated the car floating and transfer bridges) authorized the complete rebuilding of Transfer Bridge No. 12, including the replacement of the last remaining original wooden Howe truss bridge dating from 1905. It is not clear from the plans whether the truss bridge was still in service at the time. As World War II expanded in Europe, the reconstruction plans were put on indefinite hold. Following America's entrance into the war, demands to move carloads of war material across the bay to the Navy Yard and other facilities in Brooklyn, Long Island, and the Northeast increased dramatically, and the decision was made to instead build a completely new transfer bridge (No. 9) at the north end of the facility. Construction of the new bridge could proceed with less interference with the operation of the other bridges. Following the completion of Transfer Bridge No. 9 and its placement in service on November 9, 1943, work on the rebuilding of Transfer Bridge No. 12 was begun (Conrail Microfilm Drawing Nos. 066315 [1939], 118685 [1943], 118697 [1943]; New York Bay Railroad Company 1945).

The cost of rebuilding Transfer Bridge No. 12 totaled $185,000, including a new steel plate-girder main span, a new apron span, superstructure strengthening and underpinning with 132 new greenheart pilings, new concrete footings, and a new sheet-pile and concrete abutment for the shore end of the main span. The machinery was also upgraded to include a 10-horsepower General Electric (GE)/Lingerwood mooring winch; a 15-horsepower Clyde capstan; new counterweights of cast-iron, steel, and concrete construction, two weighing 42,000 pounds for the apron and four weighing 54,000 pounds for the bridge; two GE 100-horsepower operating motors; a 440-volt control panel; a control desk; and motor brakes, lifting screws, counterweight cables, and sheaves (New York Bay Railroad Company 1945).

With the decline of the rail industry following the war, maintenance of the facility was continually deferred. As rail freight traffic declined, bridges in the group were taken out of service. Today, only Transfer Bridge No. 11 is in service, operated by the New York Cross Harbor Railroad. The superstructure of Transfer Bridge Nos. 13 and 14 has partially collapsed and is in the process of being demolished.

The New York Cross Harbor Railroad runs the last car float operation in New York Harbor from its headquarters in Bay Ridge, Brooklyn. The Cross Harbor has purchased the Greenville transfer bridges and uses Transfer Bridge No. 11, the last operable suspension-type transfer bridge in the New York area, to connect with Conrail lines to the west. At the Bay Ridge end of the car float route, the company utilizes a pontoon-type transfer bridge (Roseman 1989:37).

## BIBLIOGRAPHY

Bensel, J.A.
1888 New Transfer Bridge, Harsimus Cove, Jersey City, N.J. *American Society of Civil Engineers Transactions* 19:309-312.

Burgess, George H., and Miles C. Kennedy
1949 *Centennial History of the Pennsylvania Railroad Company.* The Pennsylvania Railroad Company, Philadelphia.

Condit, Carl W.
1981 *The Port of New York*, vol. 2. University of Chicago Press, Chicago.

Conrail Microfilm Drawings (on file by number at Conrail Offices, 2 Commerce Plaza, Philadelphia)
1910 Microfilm Drawing No. 118396. General Details for Transfer Bridge No. 14. April 1910.

1924 Microfilm Drawing No. 118896. Transfer Bridge No. 10, Extension of Present Building. November 1924.

1939 Microfilm Drawing No. 066315. Transfer Bridges No. 12 and 9, Plan and Details of Apron. December 11, 1939.

1943 Microfilm Drawing No. 118685. Transfer Bridge No. 9, Suspension and Counter Weights. May 19, 1943.

1943 Microfilm Drawing No. 118697. Transfer Bridge No. 9, Superstructure Steel. May 18, 1943.

*Engineering News*
1890 Freight Transfer Bridge. *Engineering News*, January 18, pp. 67-68.

Flagg, Thomas
1994 "The Transfer Bridge at the Port of New York", Part I: *Transfer*, No. 12 (October - December 1994, pp. 12-18); Part II: *Transfer*, No. 13 (January - March 1995, pp. 10-18).

French, James B.
1917 The Development of Car Float Transfer Bridges in New York Harbor. *Connecticut Society of Civil Engineers, Papers and Transactions for 1916,* pp. 58-76.

Hovey, Otis Ellis
1926 *Movable Bridges*. John Wiley & Sons, Inc., New York.

*Hudson Dispatch*
1931a Fire at Penn. R.R. Yards. *Hudson Dispatch*, January 2, p. 1.

1931b Blaze Causes Little Halt in P.R.R. Service. *Hudson Dispatch*, January 3, p. 2.

*Jersey Journal*
1931 Rail Terminal Blaze Causes Heavy Damage. *Jersey Journal*, January 2, p. 1.

*Jersey Observer*
1931 Fire Sweeps Local Freight Terminal; Loss Near Million. *Jersey Observer*, Hoboken, January 2, pp. 1 and 18.

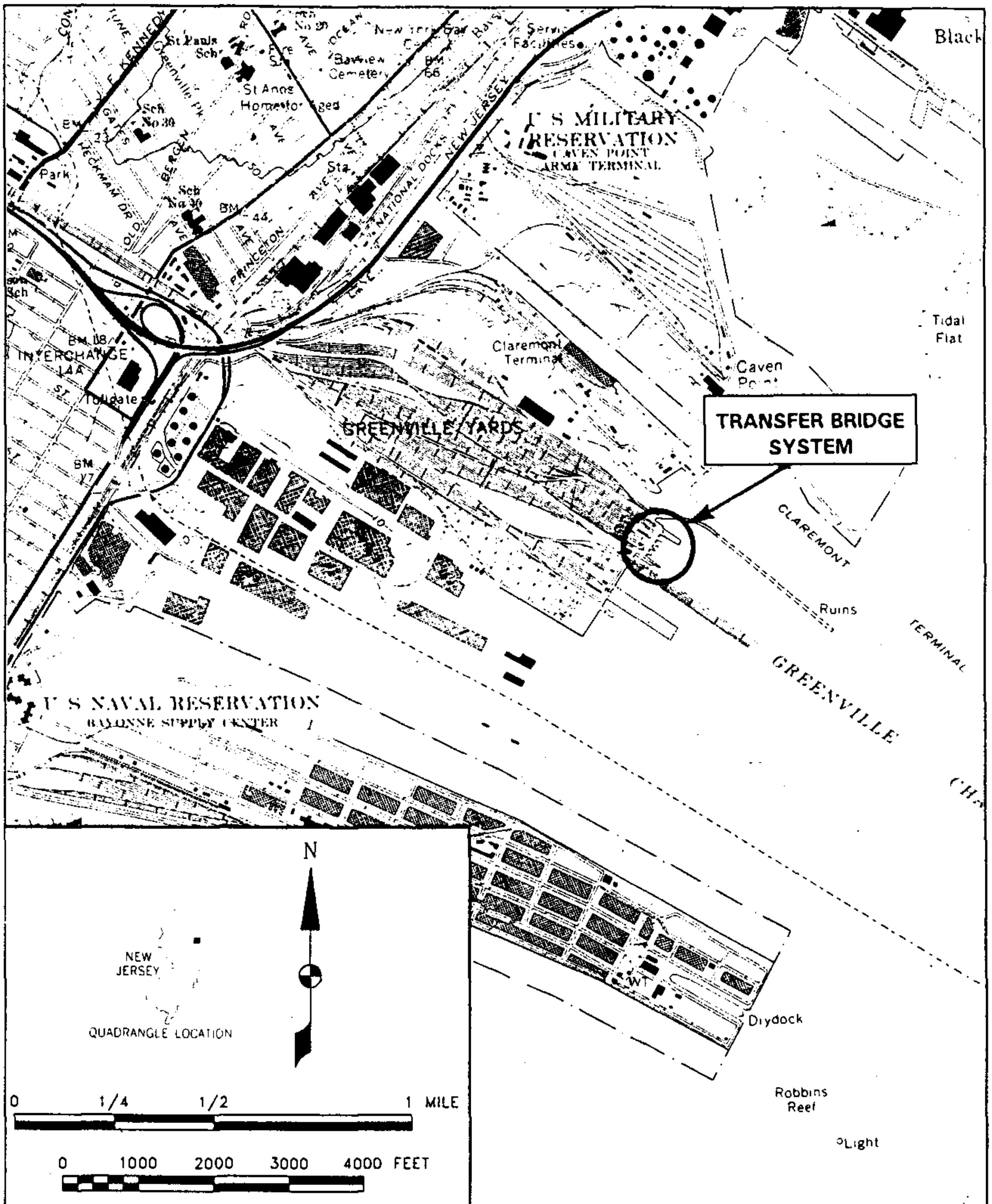
Mordecal, Gratz
1885 *A Report on the Terminal Facilities for Handling Freight of the Railroads Entering the Port of New York.* Published by the Railroad Gazette, New York.

New York Bay Railroad Company
1945 Greenville Yard Facility Records: "Project Completion Report No. 437." On file at Conrail, 2 Commerce Plaza, Philadelphia.

*Railway Age*
1905 The Greenville Yards and Transfer Arrangements of the Pennsylvania Railroad. *Railway Age*, March 24, pp. 397-403.

Roseman, Victor
1989 By Car Float to Brooklyn. *Trains,* January, pp. 36-39.

Snow, J.P.
1901 Transfer Floats, Ferries and Bridges. *Proceedings of the American Railway Engineering Association*, pp. 160-166.




**Location Map**

*SOURCE: USGS 7.5 Minute Quadrangle, Jersey City, NJ-NY 1967 (Photorevised 1981)*